EGS Abstract for
Vienna, April, 1997

TIDES IN TITAN

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Tides raised in Titan by Saturn give rise to a static and a periodic deformation: both will be measured with Doppler tracking during the CASSINI Tour of the Saturnian System. The latter deformation is due to the significant eccentricity of Titan's orbit and has a frequency equal to the orbital angular velocity of Titan. This periodic perturbation must bring out an elastic response from the satellite. The ratio of the induced potential at the surface to the perturbing potential is the elastic Love number of degree 2, k_2. The elastic Love number depends critically on the shear modulus or rigidity μ of Titan. The bulk rigidity of Titan is highly uncertain. For a rocky body, $\mu = 5$ to 7×10^{11} dynes cm^{-2}, while the rigidity of water ice is $\mu = 4 \times 10^{10}$ dynes cm^{-2} A volatile poor Titan would have a rigidity of several $\times 10^{11}$ dynes cm^{-2}. On the other hand, an internal ocean in Titan would mechanically decouple the outer solid layer from the inner mantle and core and the expected value of μ would be approximately ten times smaller. We have investigated the periodic deformation of Titan for different models of internal structure, in particular how the internal ocean affects the parameters k_2 and p and the Doppler observable; we also discuss how Doppler measurements can discriminate between different models.

Submittal Information